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RETIREMENT

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EXECUTIVE HEALTH

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DUST EXPLOSIONS

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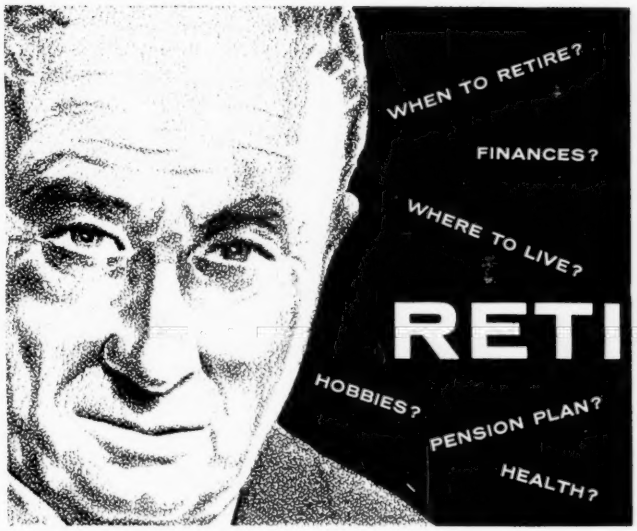


INDUSTRY AND RETIREMENT

by
IRENE KINGSTON, B-A.,
Occupational Health Division,
Department of National Health and Welfare,
Ottawa, Canada.

Why discuss retirement and the problems of retirement? There was no need to a few years ago. In the early 1900's, however, two factors emerged which required not only the individuals concerned, but industry also, to look into the whole question of retirement and its attendant problems.

One such factor was the improved health of the general population; the other the changes in our way of living.

Due to advances in medical science, not only are more Canadians living to retirement age, but the life expectancy beyond that time has also increased. A hundred years ago, the average life expectancy at birth on this continent was only 40 years. In 1951 (the latest year for which figures are available), life expectancy for Canadians was given as 66.3 years for men and 70.8 for women.[1] Since more people are enjoying better health for more years, the number free to enjoy retirement is constantly increasing. For example, in Ontario, in 1958, there were almost half a million people 65 and over, a large proportion of whom will be among those who have left the labour force.

The change in our way of living brought about by the increasing industrialization of our society with mandatory retirement at 65 has also contributed to the larger numbers of those free to pursue a life of leisure.

But an increase in the number of retired persons is not the only change wrought by the industrialization of a society once predominantly agricultural. To those growing old, our modern society presents many problems which are new and different from those of past years—problems of housing, income, health, emotional security, which will be discussed subsequently. It was estimated that in Canada in 1956, there were 100,000 employable persons living in retirement. Statistically, therefore, it behooves everyone who will some day be among that group to gain a knowledge of the most important aspect of retirement.

Retirement has been defined as "a way, not a time of life"[2]. To this definition might be added the word "new" since it is the newness or difference in one's accustomed way of living which requires many adjustments to be made.

The use of the term "retirement" to describe this new phase of life is unfortunate in that it implies seclusion or withdrawal from. It is an idea that at times is hard to get out of people's minds. Much of the pessimism with which retirement is sometimes viewed may be due to the negative connotation of the word.

Attitudes Towards Retirement

A person's outlook on life determines, to a large extent, the measure of happiness or unhappiness he will experience. This is particularly true in retirement. Success in reaching wise decisions before retirement and living a well-adjusted life afterwards depends largely on one's own secret concept of what retirement will mean, for it is the individual's philosophy which will determine how he will live. To attain a positive and favorable outlook on retirement, it will be necessary to decide objectively and with complete honesty what is truly important and what only seems so.

Attitudes toward retirement vary from those who view it "as a consummation devoutly to be wished" to those who, unable to foresee what it will mean to them, can only "guess and fear". Unfortunately, those who look forward to retirement are in the minority. During the First Ontario Conference on Aging, 1957, research findings were cited to show that 75% dreaded retire-

ment because of economic and emotional unreadiness.[3] Nor is this fearful attitude peculiar to Canadian workers. Surveys conducted in the United States and in England have shown that the majority of workers do not want to retire. In many cases, it was revealed, reluctance to retire was based on fear of loneliness and idleness rather than on economic reasons. In combating such apprehension, early planning and a knowledge of the basic needs of retirement are invaluable aids.

The Importance of Early Planning

One of the most certain means of overcoming a fearful or pessimistic outlook toward retirement is foreknowledge of the changes it will make in one's way of living. Once the nature of these changes is known, planning for them will overcome many difficulties that would otherwise be experienced. Although no one would set out on a vacation without making plans well in advance regarding destination and accommodation, and providing for the expenses involved, many people embark on a permanent holiday woefully unprepared. A study published by the Harvard Business School on "Some Observations on Executive Retirement"[4] reveals that many executives experienced retirement shock and that, in some cases, the shock was severe. These facts emphasize the tendency of too many men to go into retirement unprepared and without the necessary orientation. Obviously, whether plans concern your health, finances or psychological needs, the sooner they are made, the greater the benefits from them will be.

How early should one start to plan? One authority has stated that ten to fifteen years in advance of retirement is not too soon.

What to Plan For—For what aspects of retirement, then, should plans be made? The importance attached to different needs, whether they be physical, psychological, social or economic will vary with the individual, but the prime requisite for enjoying life at any stage is adequate physical and mental health.

Health—In planning for adequate physical health after retirement, proper dietary and living habits, as well as regular medical and dental examinations throughout life, constitute a minimum of preparation. As the time for retirement draws nearer, it would be well to consult your doctor. He can advise you on what kind of physical life you should lead and other aspects of health related to retirement.

In addition to what the doctor advises, it is wise to give careful attention to the things that affect you emotionally and the degree to which they affect you. Remember that the emotions have a profound effect upon the body and therefore their importance to mental health should not be minimized or overlooked.

When to Retire—Among the many plans and decisions which should be made before retiring, the decision of when to retire is one of the first that should be made as it affects other plans, e.g., where to live, how much money will be needed, etc.

When should *you* retire? Unfortunately, there is no pat answer to this question that will fit every case, as the age for retirement will vary from individual to individual. However, there are certain guide-posts that will help you reach a decision.

Retire While in Good Health—A prompt adaptation to retirement will be made more easily if one retires while in good health, because good mental health is dependent upon good physical health.

Retire Early—In addition to good health—for vigor is comparatively undiminished in the middle fifties—there are other advantages. The idea of new interests and activities is more appealing than it might be 10 years later; one is more pliable mentally, more venturesome and more receptive to all the varied aspects of the new life at this age than would be the case at the compulsory retirement age. Further, in early voluntary retirement there is little loss of prestige, little fear of impending old age and a substantial span of time ahead to enjoy the new life. In the case of enforced retirement at 65, nearly all these favorable elements are lacking and, worse still, they have been replaced by unfavorable elements.

Finance—Today, when higher living costs are rendering inadequate incomes formerly deemed to be sufficient and when inflation is reducing the yield on certain investments such as insurance,[5] it is all the more necessary to make careful plans for an adequate income. If advice in this matter is needed, a good insurance man can give helpful suggestions and the banker, lawyer or investment dealer can each help in his own way.

The amount of income required to live comfortably will, of course, vary with the individual, depending upon where and how he and his wife wish to live and upon the value they place on money. "One retiree may live happily in a fisherman's hut, while another would sulk if he had to give up his yacht".[4] Providing an adequate income to ensure the ordinary comforts of life is, however, a necessity in order to maintain good health and to avoid loss of prestige and self-esteem which would result from becoming financially dependent upon others.

Where to Live—Their financial position is, for many people, a determining factor in deciding where to live, while for others this question is not a problem. On the other hand, some may lack money or the physical or mental self-sufficiency to carry on alone in their apartment or house; making a home with their children may not be possible, or there may be no children.

The first decision to be made is whether to remain in the same town or not. Before going elsewhere, it is wise to investigate any specific place one has in mind, either by visiting it for a few weeks or through making detailed enquiries from those who live there. Recreational and educational opportunities, cost of living, and the attitude toward persons of a particular age, race or creed are all factors that should be looked into.

Intensely populated communities are undesirable for the second half of life. A large city tends toward the isolation of an individual. There is too much tension and speed and not enough opportunity for older individuals to walk and be outdoors among people. A common summertime sight in a city like New York is the old people sitting on benches between two lines of cars watching life go by, and convinced that the role of an onlooker is all that is possible for them now.

Although everyone becomes more of a spectator as he grows older, there is a difference between looking at the throng through a vapour of gasoline and dust to the accompaniment of traffic's hum and watching it pass from the verandah of a home in a small town where one sees and is seen by friends and acquaintances.

For older people who have lived in a city, life on a farm would not be appealing. They would miss the educational and recreational facilities to which they had been accustomed and might experience an isolation hitherto unknown. One authority on the subject of retirement has stated that older people seem to find towns of 15,000 to 50,000 most suitable as a place to live.

Hobbies:—No matter where one lives, knowledge of and a lively interest in a number of things will contribute much to the enjoyment of the leisure time which retirement affords. A great deal has been spoken and written about the desirability of having a hobby, but the whole purpose of a hobby, which may be said to be that of providing activity that is intellectually absorbing and satisfies the need for a sense of accomplishment, will be defeated if the hobby is not well chosen.

Hobbies cannot be picked up at random overnight. One must select, investigate and experiment and then go on to develop ones that seem the most promising. Since they are of a particularly personal nature, the decision of which ones to pursue must rest with the individual. Fortunate are those who have many, as several hobbies lend variety to life.

Psychological Needs

Having considered physical needs such as health, finances, housing, we must now turn our attention to the psychological needs which are inherent in retirement.

Broadly speaking, there are four such needs.[6] First, there is the *need for a feeling of belonging* or inter-personal relationships. In childhood, the need for such relationships is satisfied through the family and the school. In adult life, one of the major sources of this satisfaction is to be found in work. This is particularly true for single people whose inter-personal family relationships are broken as the older generation dies and they find themselves cut off from close family ties. For this group, work provides a substitute for the family and in some cases is a major support in inter-personal relationships. As one means of meeting the need for a feeling of belonging, it is important for the single woman to have her own apartment or cottage. It is one place where she feels she belongs, and which provides a means of self-expression.

The second psychological need is the *need for learning or progress*. During our early years, our environment is constantly changing and this presents challenging or learning situations which make it easy to satisfy the need for progress. As we grow older, there are fewer and fewer things or situations that are completely new to us. We may therefore conclude that we have less learning ability, but psychological studies have shown that reduction in the capacity to learn is negligible until the time one becomes senile. Because we meet few new situations in the course of our everyday living, we tend not to challenge ourselves by seeking out the new and unknown, and thus get out of the habit of learning.

In planning a programme to meet this need, we should include new interests and skills apart from the field of employment. Too often new learning gives satisfaction only when it results in advancement in the work field, but to be of value in retirement, it needs to provide satisfaction arising from the new interest itself. Such a sense of achievement will in no way be threatened by retirement. It is wise to plan to learn something new each year.

This sense of progress partly satisfies the third psychological need, *the need for a sense of self-esteem*. A complete lack of personal worth could lead to self-destruction, therefore self-esteem is essential to life. This implies that we have to have "something" to build on and that we should be able to make a contribution to our inter-personal relationships with others.

As work, or employment, can satisfy the need for a sense of learning and progress, so it is with the need for a sense of self-esteem. For some people their job may be the only area in which they have a sense of competence, consequently failure to meet a challenge here may be very damaging to that individual's sense of worth. For this reason, an older worker may fear and resent change in work methods, as they constitute a

threat to his sense of security. Thus, while for some, work may provide the satisfaction of a need for self-esteem, for others the job situation may present a pitfall in the failure to meet a challenge.

The fourth need, *a need for a sense of social purpose* is satisfied to some extent by the contribution which we make to others in an attempt to satisfy our need for self-esteem. We cannot live selfishly; we must have a realization of our worth to others and a sense of our own worth as individuals.

Industry's Retirement Programme

In meeting any problems which retirement may present, the individual is not left to his own devices in seeking solutions. Industry's programme to aid the worker to adjust to his new life is already comprehensive and is continuing to expand as new needs become evident.

Pension Plans—The earliest retirement schemes were plans financed by the employer to reward a worker for long faithful service when he became disabled and unable to carry out his normal duties. As time passed, particularly after the start of World War II, and Canada became industrialized to an extent hitherto undreamed of, there was keen competition for workers and organized labour became stronger. In these circumstances, pension policies were crystallized into pension plans.[3]

During war time, this movement was strengthened because wage controls were in effect and pension plans became a way of providing fringe benefits in Canada. Further impetus has been given by introduction of income tax exemption for money contributed to approved pension plans.[3]

Retirement Age—In order to determine the amounts of contributions and benefits, the actuary must have a "normal" retirement age set for the basis of his calculations. A recent survey showed that the responsibility for the retirement of workers at the "normal age" rests with the administrators of the plans in many instances, rather than with the terms of the pension plan itself.

Financing of Pension Plans—The majority of pension plans in Canada are supported jointly by employers and employees. Usually, in contributory plans, the worker is entitled to the amount he has contributed and generally some money is returned by the employer if the man leaves the firm before retirement. Generally, the employer's contribution is in the form of an annuity, the amount depending upon his length of service. Sometimes, after 20 years with the same company, the equity is paid in full.[3]

Non-contributory plans are of recent origin. They are generally introduced through collective bargaining and are found in large firms. Rarely is the worker given an equity in the fund if he leaves before retirement. The employee who changes his job, therefore, is at a disadvantage in acquiring financial security for his retirement. On the other hand, the long-service employee does not have the security for his old age that the pensions seems to suggest, because many plans yield a flat rate benefit and others base the pension on life-long earnings. Therefore, at the time of retirement, the pension may have become quite unrealistic in terms of the cost of living.[3]

Protection of Workers' Rights under Pension Plans—In Canada, there have been few abuses, largely because of the vigilance of the Department of National Revenue, and, to some extent, the Federal Department of Insurance. In order to obtain exemption from income tax, pension plans had to be approved by the Department of National Revenue. In cases where the benefits were not underwritten by an insurance company actuarial, supervision of such funds became the responsibility of the Federal Department of Insurance which applied strict requirements of solvency and soundness.

The Department of National Revenue has always insisted on the inclusion of a vesting provision so that, upon completion of a reasonable period of service and/or the attainment of a specific age, employees became fully entitled to pension benefits even if employment terminated before the normal retirement. In the past, the practice was to grant vesting upon completion of 20 years' service. More recently, the required period of service has tended to be shortened to 10 to 15 years.[3]

Benefits—One of the most important problems is the establishment of adequate benefits. The rapid increase in the cost of living has made inadequate standards which had formerly been considered adequate. The problem is twofold.

The first difficulty concerns the provision of a benefit which will be sufficient at the time the employee retires. Since most pension plans provide benefits based on career earnings, this, in itself, has become a serious problem in recent years. Advances in the cost of living after retirement represent a further difficulty which has been widely experienced in the past few years. The first problem can be solved by relating pension benefits to final average, rather than career average earnings, but little or no progress has been made in solving the second problem.

Pre-Retirement Counselling — Once socially-conscious industries had established pensions, they felt that they had discharged their responsibility to the employees. Everyone would have a pension, would retire and live happily ever after. However,

as time passed, they found that many people were not living happily; that an adequate means of support was not all that was necessary; that people needed some way to prepare themselves to enjoy or to spend these later years profitably. Consequently, many firms started counselling plans.[3]

Types of Programmes—The aim of any pre-retirement counselling programme is to convince the employee that he has nothing to fear if he plans realistically for his future as a senior citizen.

In preparing a programme, industry may at first encounter difficulties and find that many questions arise. What type of programme should be adopted? By whom should it be conducted? What matters should be included for discussion? When and how often should discussions take place?

Industry's answers to these questions vary, based upon experience of the worker's needs. There is, therefore, a difference in the types of programmes and the frequency with which they are held. In any case, counselling is usually done by a member of the Personnel and/or Medical Departments.

Private Interview—In some industries, counselling is limited to interviews in which the individual's pension is discussed. Other companies arrange for a series of interviews at the request of the worker. Still other firms request an interview with the employee a year before he retires. He is asked what plans he has made for retirement and, if he has not made any, he is assisted in making preparations and decisions. In private interviews of this kind, some industries have included the employee's wife, since his retirement affects both of them.

Group Lectures—In this form of counselling, lectures are given periodically, perhaps once a month. All aspects of retirement are discussed except possibly health where counselling is done by the Medical Department.

Counselling by Medical Department — The counselling services provided in the worker's earlier years may have contributed much to his health and job satisfaction, but he will no doubt find pre-retirement counsel of even greater value. The doctor will be able to advise him on the special aspects of health related to retirement, such as the kind of life he should live, the climate and altitude best suited for him, etc. If there is a psychiatrist on the staff, he will receive advice on any psychological problem that retirement may present.

Appraisal of Programmes Value—Management feels that pre-retirement counselling is very important in building a confident attitude among persons who are retiring and in making the older workers who have left the organization feel that people care about them.

During a national conference on retirement of older workers, it was notable that those firms with the greatest experience were the most enthusiastic about a counselling programme.[7]

Health Services — Pre-retirement counselling in relation to health is only one small part of the health services provided by modern industry. Commencing in the early 1900's as a first-aid and home visiting service, these services have continued to grow until to-day they include examinations, supervision of the occupational environment, health education and counselling, in addition to the two initial services.

Periodic health examinations are of great benefit to the employee at any time, but particularly to the employee soon to retire as he will be treated for any disability or impairment of health which may be discovered and by the time he leaves the firm he will be in good health.

The Medical Department's supervision of the occupational environment, which includes safety programmes and attention to potential occupational hazards, has resulted in a substantial reduction of crippling accidents. Many more workers, therefore, are going into retirement today free from handicaps due to industrial accidents than their predecessors who lived in a generation when there were no safety programmes.

Through the Medical Department's education programme, the employee will have received instruction on nutrition, management of illness, etc., knowledge which will benefit him the rest of his life and will enable him to deal more effectively with health problems in retirement, should they arise, than would otherwise be the case.

Retirement Practices

As time passed, industry realized that despite their existing programmes, retirement was still creating problems far-reaching, and sometimes serious, in their consequences. Management found that many employees did not want to retire and that the current practice of superannuating them at a fixed age was having a widespread effect on the individual, the community and the nation's economy. Aware of these conditions, and conscious of the steadily growing ranks of retired persons, some industries are examining their retirement practice and assessing the effectiveness of their programmes.

Retirement at a Fixed Age—Usually referred to as arbitrary or compulsory retirement — is one of the earliest and remains one of the most general retirement

policies. It was inaugurated in the United States some years ago and became popular in both Government and industrial groups. In some companies, the age was arbitrarily fixed at 60, but more generally at 65. No one knows who picked these ages. There is no authority for them and the only reason seems to be the actuarial need of a "normal" retirement age on which benefits may be calculated. At any rate, society came to accept the dictum that one's business or industrial career is finished at 65.

Why favoured by employers—Obviously it is the welfare of the organization and not that of the individual employee that is the main objective in such plans. Reasons compulsory provisions are considered desirable by employers include:[3]

1. Turnover of senior staff is needed to encourage younger employees. (One company reported that it considered that the morale of the employees would suffer if promotions were blocked or delayed by retention of personnel beyond pension age).

2. Increases in production due to automation or technonological advances frequently reduce the need for manpower. The retirement plan provides a way of effecting such a reduction.

3. In times when there is a surplus of manpower, management problems of employment of special staff are eased by such plans.

4. The objective standard provided by arbitrary retirement is not subject to favouritism and does not reflect in any personal way on the individual involved[2].

Unfavorable Factors—Without passing judgment on the foregoing reasons, certain disadvantages become apparent in a study of the retirement practice based on age alone; disadvantages based on physical, economic, and social factors.

Physical—One authority on the subject of retirement is of the opinion that the policy of fixed retirement has contributed to the rapid increase in mental illnesses.[8] Also, as previously mentioned, retirement of executives while in good health caused retirement shock so severe in some instances as to be fatal. Further, Lawton has stated that although "there is no systematic research to prove this, psychologists and medical men, on the basis of their clinical observation, believe that of two men, equal in all other respects, the one who keeps on working at a job he likes and can handle will live longer than one who retires."

Economic—Fixed retirement puts a severe strain on a nation's economy, a strain which any nation can ill afford. In addition to the loss of production which is involved there is also the financial burden of maintaining dependent retired persons.

With reference to the loss of production, Prof. Slichter of Harvard University has estimated that the loss of production from retired workers in the U.S. in 1951, to be approximately 3.8 billion dollars. Neither the U.S. nor Canada can afford such a waste of manpower, particularly in view of the labor force required to meet these nations' defence programmes. That such a policy is wasteful from the point of view of efficiency has been proved. It has been shown that absenteeism is lower between the ages of 60 and 75 than between the ages of 20 and 40.

If rigid rules of retirement, based on chronological age, had been applied universally in the past, it is difficult to see what would have happened to the world with the loss of such men as Churchill, Einstein, Bernard Baruch or Verdi who wrote his greatest opera after he was 80. Someone may remonstrate that these are exceptional individuals and therefore they are not an indication of what the average person does. In rebuttal, it may be said that physicians are not compulsorily retired at age 65; yet 8 out of every 10 physicians over 65 in the United States are practising medicine to-day. Many of them are responsible for whole communities and are doing a very credible job.[9]

Referring to the burden of maintaining those in retirement who are not financially independent, the President of a Canadian University has stated that "the number of older people is increasing to proportions which virtually defy the nation's ability to support them in unproductive roles".[10]

Social—Not only has this practice been found economically unsound, but it has also heightened the already difficult social problems to which the older person must adjust. Advances in new medical knowledge, largely responsible for the increase in the number of old people has not contributed in a comparable degree to knowledge in the field of social science. Comparatively little is known about the science of aging. We do know, however, that social adjustment is difficult for old people. In the past, the problems associated with society's older members were mainly the concern of the family. With the trend from rural to urban population and from an agrarian to industrial economy, the significance of the family has been weakened, particularly for the aged.

Many social contacts are lost or seriously disturbed when an older person is removed from the labour force. Almost all his group relationships are lost if he is not dependent on his children and if he moved to another section of the country. He is confronted with many problems which threaten his security, financial and social-psychological.

Alternative Retirement Pactices

Gradual Retirement —

Since the practice of fixed retirement has posed so many problems, business and industry have been trying other policies.

In the United States, the Director of Health, Education and Welfare is planning a new approach to job retirement for employees of the Federal Government. This system will permit an individual to taper off work as he nears retirement. The United States Government has compulsory retirement at 70 for Federal employees.

Under this system, an eligible individual of 62 would be retired, then re-hired for a "tapering off work schedule". He would work a gradually decreasing proportion of his time for a period of five years—or until he reached 70 whichever is the earlier.

Five ways of tapering off work are now being explored by the Department's personnel officials. These include —longer vacations each year, a shorter work week, a shorter and shorter day, a gradual shift in responsibilities of the job to younger men and, finally, a transfer of an aging worker to a less demanding job. Industry has already tried some of these approaches.

A life insurance company gives its employees ten weeks vacation in their last year of work before retirement. They are encouraged to take one-half of this time off in the first six months of the year, and the remainder in the last six months.

A comment from a spokesman of one industry which has adopted the gradual retirement plan reveals the plan's objective. "The main purpose of the programme is to give the employee time to try out plans he has developed for retirement or to explore places he may want to retire to. It also gives his replacement a chance to function but still have opportunities to talk over the job questions before the experienced man finally retires".[11]

Trial Retirement—A manufacturer of chewing gum is experimenting with a type of trial retirement. When an employee is about 64, he takes an extra month's vacation without pay and when he is 65 he takes three months. Eventually he reaches a point where it is not financially desirable for him to continue to work.[5] Another source[11] in commenting on this plan has pointed out that by the time the employee is 69, his pension fund, which has continued to increase actuarily, plus his Social Security Benefits, make it possible for him to get a bigger cheque by retiring than by working.

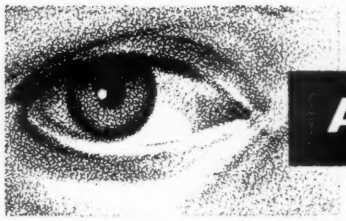
Conclusion

With pension plans as a beginning, industry through the years has constantly striven to meet the needs of the ever-growing numbers of retired persons, and to this end has included health services and pre-retirement counselling.

A successful person, it has been said, is one who has the ability to solve prople's problems and to do something useful for them. Measured by this yardstick, industry's retirement programme must be deemed eminently successful.

REFERENCES

1. D.B.S. direct.
2. Aging Successfully, George Lawton.
3. Aging is Everyone's Concern — The Proceedings of the First Ontario Conference on Aging, 1957.
4. Retirement, Clifford Hart.
5. Bulletin of the New York Academy of Medicine, 1957, Vol. 33, No. 1, page 46.
6. The Meaning of Work and Retirement, Margery R. King, Ph.D., Occupational Health Review, Vol. 9, No. 2, July 1957.
7. National Conference on Retirement of Older Workers, Geneva Mathiasen, Editor.
8. Geriatrics and Retirement, Anthony Salamone, Ind. Med. & Surgery, Vol. 27, No. 8, page 417, August 1958.
9. Problems of Retirement in Industry — Chicago Heart Association.
10. Ottawa Citizen — Oct. 9, 1956.
11. Around the Town with Walter Gilhooly, Ottawa Journal, Sept. 27/58.



PRINCIPLES IN THE MANAGEMENT OF ACUTE OCULAR TRAUMA

by David A. Rosen, M.D., F.R.C.S.(C),
Department of Ophthalmology, Queen's University, Kingston, Ontario.*

Minor and major traumatic accidents of the eye are seen frequently in the industrial environment. Early and suitable treatment will serve to minimize the sequelae of such injuries.

Acute ocular trauma may be considered in the following categories:

1. *Non-penetrating:*
   Mechanical, sharp or blunt
   Chemical
   Thermal
   Radiational
2. *Penetrating.*

Non-Penetrating Mechanical Sharp Trauma

Non-penetrating mechanical trauma by sharp objects usually takes the form of foreign bodies. Some of these are adherent to the surface while others will be found imbedded in superficial layers of the eye. Favoured sites for imbedded foreign bodies are the upper palpebral conjunctiva and the cornea. The former are readily visualized by everting the upper lid and can usually be removed with a simple cotton-tipped applicator. Foreign bodies adherent to the cornea usually require a spud for their removal. These foreign bodies may be superficial or deep and may be located in the peripheral or central regions of the cornea. The following measures must be taken in removing corneal foreign bodies:

1) The cornea must be thoroughly anaesthatized. A single installation of 0.5% tetracaine (pontocaine) usually suffices.
2) Good illumination is essential. For deeper foreign bodies the illumination and magnification provided by the slit lamp biomicroscope is ideal.
3) The process of removal should traumatize the cornea as little as possible. It should be remembered that any injury which penetrates the Bowman's membrane of the cornea will lead to corneal scarring. This will be particularly important in central involvement of the cornea.
4) If a foreign body is resistant to removal with ordinary instruments, the patient should be referred to an ophthalmologist for removal under slit lamp observation.
5) After removal of a foreign body, the installation of 2% homatropine will minimize the ciliary muscle spasm which is so often responsible for the discomfort which follows an injury during the healing period. An eye pad applied for twelve to twenty-four hours will likewise bring about symptomatic relief. Topical antibiotics or chemotherapeutic drugs are only indicated in the more severe injuries, in instances of long-standing foreign bodies and where there is obvious evidence of tissue necrosis or infection.

Non-penetrating, sharp mechanical injuries of the eye may also take the form of lacerations of the eyelids, conjunctiva or cornea. Eyelid lacerations which affect only the skin and muscle layers may be sutured by ordinary techniques. Where the laceration involves the tarsus, the entire thickness of the eyelid or the lacrimal canaliculus at the inner canthus, the patient should be referred for careful anatomical apposition of the structures in order to minimize eyelid deformities and to prevent troublesome epiphora.

Simple conjunctival lacerations and non-penetrating corneal lacerations may ordinarily be handled by the the installation of homatropine and the application of an eye bandage for twenty-four to forty-eight hours.

Non-Penetrating Mechanical Blunt Trauma

Non-penetrating, mechanical, blunt trauma of the eyes may give rise to a variety of early and late complications which may, in some instances, be disastrous. These include the following:

(1) Traumatic mydriasis of greater or lesser degree. The pupil will be dilated, frequently irregular and very sluggish in its direct and consensual reactions. This abnormality of the pupil will ordinarily persist indefinitely. The possibility of such happening should be considered in the differential diagnosis of the pupillary abnormalities which occur after acute head trauma. Specifically, a unilaterally dilated pupil may result from direct injury to the eye rather than as the remote effect of an intracranial hemorrhage.

(2) Traumatic anterior chamber hemorrhage (hyphema) is a common occurrence after blunt trauma. The patient with a traumatic hyphema should be regarded as having had a potentially serious injury of the eye. Many of these patients bleed recurrently and in these instances disastrous complications such as secondary glaucoma, organization of the hemorrhage and blood staining of the cornea may ensue. The possibility of such occurrences and complications may be minimized by keeping the patient at bed rest until the hemorrhage is completely absorbed and reasonably quiet during the four or five days when secondary bleedings may ensue. It is considered by some advantageous to employ a miotic such as pilocarpine in order to provide a larger surface of iris for absorption of blood.

(3) Iridolialysis, the tearing away of the iris from its root over a variable portion of its circumference, is a result of a more severe ocular injury. It is usually accompanied by an anterior chamber hemorrhage. As an isolated defect it does not usually produce important symptomotology.

(4) Traumatic cataract will occur as a "concussion" change in the eye in severe injuries. The cataract may be of early or late onset and may be stationary or progress rapidly to maturity.

(5) Lens dislocation is likewise an aftermath of more severe grades of ocular trauma. When the lens is merely subluxated there will be visual impairment from the astigmatism induced. When totally dislocated, the vision will be prominently reduced due to the elimination of the refractive functions of the lens. Late complications of lens dislocation include secondary glaucoma, prolonged cyclitis and retinal detachment. The possibility of such sequelae frequently constitutes the indication for surgical removal of dislocated lenses.

(6) Vitreous hemorrhage is recognized when one is unable to obtain a red reflex from the fundus with the ophthalmoscope. Vitreous hemorrhages are notoriously slow to clear and usually leave a degree of vitreous degeneration and opacification. In some instances this may give way to organization by blood vessels and connective tissue having their origin in the retina.

(7) Retinal hemorrhages and edema may follow on severe blunt trauma. These have a predilection to occur in the macular region (Berlin's edema). This will almost invariably result in a greater or lesser degree of impairment of macular function which is permanent.

(8) Retinal detachment will follow if the injury leads to the development of a retinal tear or a disinsertion of the retina at the ora serrata. These are more likely to develop in eyes which are predisposed by myopia, aphakia or congenital retinal cysts. This is a serious complication and the prognosis for surgical restoration is more limited than in spontaneously occurring retinal detachments.

(9) Non-penetrating mechanical blunt trauma may also lead to lid and conjunctival ecchymosis. These are minor happenings and while at times presenting a rather frightening appearance, invariably clear without residua. Cold, followed by hot, compresses, the time-honoured treatment, will at least keep the patient busy.

10) Abrasions of the cornea and conjunctiva are likewise, in the majority of instances, innocent happenings. The patient will obtain symptomatic relief by the use of homatropine and an eye dressing for the duration of the healing.

Non-Penetrating Chemical Injuries

Chemical injuries of the eye require urgent treatment. Whether in liquid or particulate form, it is necessary to eliminate the offending chemical as rapidly as possible. Ordinarily, the only means at hand for this are tap water or sterile saline. These should be employed in large volumes with an irrigating apparatus such as an ear bulb syringe. The irrigation should be continued until it is considered that every trace of the chemical has been removed. Where the offending chemical is known, chemical neutralization should be employed if possible. The search for neutralizing agents should not be permitted to interfere with emergency mechanical irrigation with available fluids. A useful agent to treat acid burns is 3% sodium bicarbonate solution while 0.5% boric acid or acetic acid are useful in the treatment of alkali burns.

Most chemical burns are fortunately of minor severity and injure only the epithelial layers of the ocular surface. Injuries by more concentrated materials may lead to necrosis of the conjunctival and corneal stroma and to permanent corneal opacification. This is particularly likely to result in the case of alkali burns. The results obtained by late corneal grafting in these cases are frequently disappointing.

Thermal Injuries

Thermal burns of the eyelid and eye may give rise to deformities of the eyelid, adhesions between the lids and surface of the eye and corneal opacities. The first-aid management is that of burns of other areas of the body. The eye should be dressed with a material such as gelonet or xeroform gauze. There is a trend towards the placing of early split-thickness grafts of skin in instances of third degree burn. Late repair of deformities frequently calls for ingenious and extensive plastic procedures.

Radiational Injuries

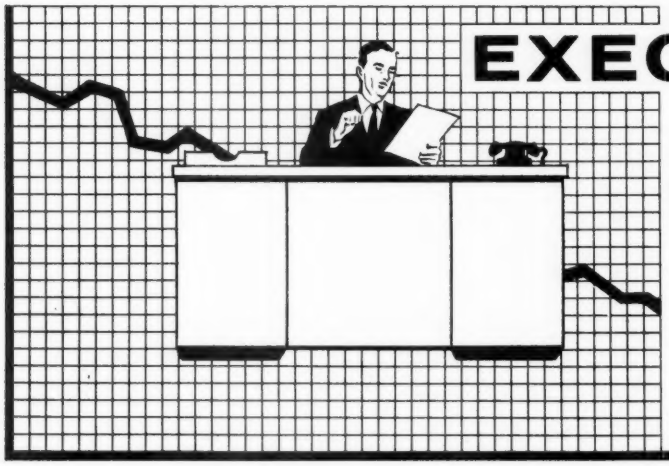
Radiational injuries in industry usually occur through excessive exposure to ultraviolet light as in the common "flash" burn. Typically, there is a latent period varying inversely with the extent of exposure before the onset of symptoms of pain, severe irritation and photophobia. These symptoms result largely from ciliary muscle spasm which is triggered by necrosis of the corneal and conjunctival epithelium. The treatment consists of the installation of a cycloplegic such as homatropine and the use of analgesic drugs and cold compresses. The use of surface anaesthetics such as tetracaine for purposes other than to facilitate the initial examination is to be deplored. These agents are toxic to regenerating epithelium and delay ultimate healing.

Penetrating Injuries

Penetrating ocular trauma requires the attention of an ophthalmologist. Indications of ocular penetration include distortion of the ocular curvature, the visualization of an obvious laceration, the recognition of prolapsed intraocular contents and the detection of ocular hypotony. The possibility of ocular penetration must be considered if a history of a flying object is elicited, if a track of air is recognized in the vitreous or if an X-Ray demonstrates radio-opaque material within the eye.

The emergency treatment of the patient with a penetrating ocular injury should consist of nothing more than the application of sterile dressing and the rapid transfer of the patient for definitive care. Ocular lacerations require prompt repair, prolapsed tissues must be either reposited or excised and intraocular foreign bodies must, wherever possible, be removed. Early enucleation is advised where the initial examination reveals injury of such severity that useful vision may not reasonably be anticipated. Where the prognosis is doubtful, a repair procedure is carried out and a decision about enucleation must be made within the first fourteen days in order to provide absolute prophylaxis against sympathetic ophthalmia.

*This paper was presented at the Industrial Medicine Conference (Ontario-Quebec) in Kingston, Ontario, Sept., 17-19, 1958.



EXECUTIVES ARE LOSING FIGHT FOR LONGER LIFE

by Arthur Pedoe*

A "keener sense of living" seems to be bringing higher mortality risks to the top businessman and professional . . .

What occupation is most favorable to long life?

It used to be said that the clergyman lived longest.

One visualized an Anglican clergyman in a country rectory without worry, strain or care.

This is not so now, according to the latest figures.

The Anglican clergyman is still better than the average with a death rate of 81% where the average is 100%.

But the farmer with 70% is much better off, and the teacher at 66% of the average is better than them all.

How about the top business executive, the top civil servant, doctors, lawyers?

They are just average at 100%.

At the other end of the scale — the unskilled worker and laborer — the death rate is worse, 118% of the average.

Not long ago the famous British actuary Sir William Elderton challenged the idea of longevity being associated with occupation.

"If all the unskilled workers were turned into professional men", he asked, "do you mean to say their mortality would be reduced?"

The answer seems to be yes.

Death by Social Class

Figures have just been issued by the British Registrar General on an investigation into mortality by occupation.

It is the 10th of a series begun in 1851.

The latest report (which we will call the 1951 report), covers the period 1949-1953.

There is a gap of 20 years between this report and the previous one because of World War II.

For the last 30 years these reports have traced the influence of social class on mortality.

It seems more reasonable to put the emphasis on man's whole environment rather than just his occupation.

Housing, education, food habits, attitudes toward health should determine the death rate rather than just occupation.

Rather than try to trace hundreds of occupations we can concentrate on five social classes.

Top brass loses out

The figures show that with improved living standards the death rate among working-class people is getting better and among top businessmen and professionals it's getting worse.

In 1921 the relative death rate among unskilled laborers was 50% higher than among top businessmen, doctors and lawyers and other professionals.

The 1951 report narrows this gap to 18%.

A limited investigation some years ago showed that the British findings applied also to the U.S. and a recent provisional report based on the 1951 census confirms it.

There are no corresponding figures for Canada.

The British statistics, however, seem to confirm what we sense to be going on in Canada and what information we do have agrees.

Women dominate

Women will dominate the English-speaking world by sheer numbers.

Between 1931 and 1951 the death rate among young adult men fell by one half.

But among women it fell by two thirds.

*Reprinted from the Financial Post, Nov. 22, 1958.

With men, the improvement in mortality rates seems to peter out about 55.

With women it continues to near the end of life.

For men from 55 to 65 the mortality was higher in 1951 than in 1931.

These are Canadian figures, but the general trends apply also to the U.S. and Britain.

We must visualize a world where women will outnumber men by outliving them, with the proportion of elderly widows increasing with each generation.

Narrowing the gap

In 1921 mortality tended to improve as we rose in the social scale.

Mortality in unskilled laborers was 125% of the average, improving by class to 82% among top executives and professionals.

In 1931 the trend was similar but the gap between top and bottom was narrowing.

In 1951 there was a similar improvement in mortality beginning with class II — managers, business owners and teachers — but class I — top executives and professionals — had got out of line.

The gap is narrowing here, too.

These trends are confirmed by the experience of life insurance companies in Canada and the U.S. who have noticed a narrowing between death rates in their "ordinary" and their "industrial" or "weekly premium" business.

"Keener living . . ."

Why are the top businessmen, doctors, lawyers and other professional men losing out?

One would have thought that medical advances in the last 30 years would have benefited these men first.

We have come to look upon high mortality rates as a penalty that goes with lower living standards but the figures show that a higher living standard — or should we say a keener sense of living — brings its own mortality risks.

Improvement in the death rate of top executives and professionals under 54 was nearly as good between 1931 and 1951 as the improvement in the other classes.

But from age 55 on, mortality rates of the top class became worse in relation to the other classes.

In the active years 55 to 64, when the doctor, lawyer and chief business executive are at their peak ability their death rates are worst.

DEATH RATE BY SOCIAL CLASS

MEN All Classes Combined = 100

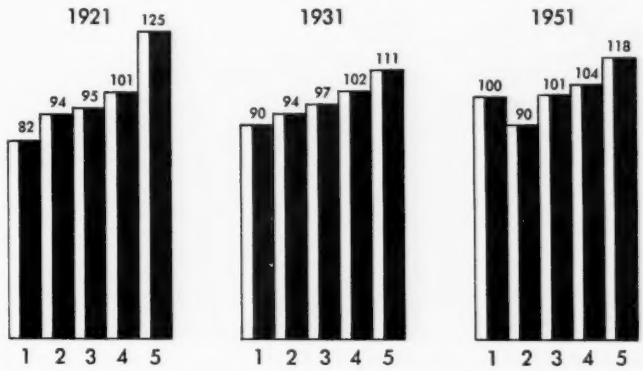
Class 1: Top executives and company directors, professions of law, medicine and the churches, stockbrokers, bankers and professional engineers.

Class 2: Management and owners of businesses, farmers, teachers and accountants.

Class 3: Skilled occupations, clerical staff, sales-clerks, salesmen, foremen.

Class 4: Semi-skilled occupations, machine-minders and agricultural laborers.

Class 5: Unskilled occupations, laborers.



The relative mortality of unskilled workers to the top class in these three periods was 152%, 123% and 118%.

If we compare the skilled mechanics group with clerks and salesmen — "blue-collar" workers with "white-collar" workers — the ratios are 106%, 105% and 103%.

Chief reason is heart disease.

As the social class falls, death rate from heart disease rises.

Between 55 and 64 degenerative diseases such as heart impairments begin to show themselves.

The 1931 report gave currency to the idea that doctors were doomed to die of heart disease.

Relative death rate of medical men from heart disease in the report was 368% or more than 3½ times the average.

For top business executives and lawyers the figure was more than twice the average.

The 1951 report shows the heart-disease death rate for doctors at 159%.

Fashionable disease

Figures on the cause of death depend on the doctor's diagnosis recorded on the death certificate.

There are fashions in recording causes of death, and this undoubtedly affected the 1931 figure of 368%.

"Coronary disease" is the commonest form of heart impairment recorded as the cause of death of men in active life, but more than 50 years ago it seems to have been rare.

To avoid criticism that figures of deaths from coronary disease are due to fashions and changing registration procedures, let's take the whole group of diseases which doctors call cardio-vascular renal or CVR disease.

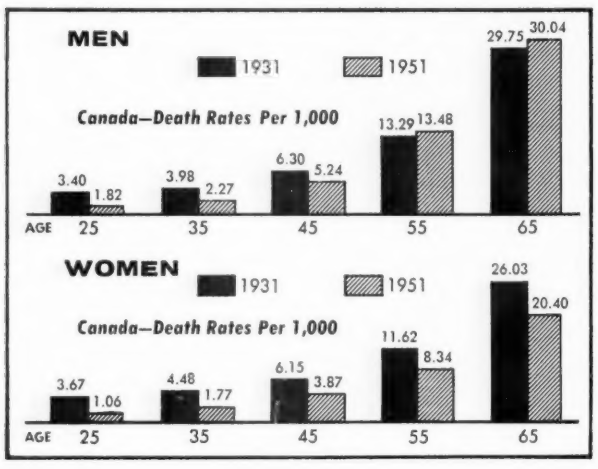
These include various "strokes," high blood pressure, heart disease of every kind, and kidney disease.

Some of these are often associated together on the same death certificate.

Here the "fashionable" coronary disease is included with the others.

Top executives and professional men have a death rate from CVR disease 122% of the average with doctors 129%.

The five social classes, from top to bottom, give CVR death rates of: 122%, 102%, 86% and 102%.



Wives survive

How do wives fare with heart disease or CVR?

Relative mortality rates from CVR for wives of men in the various classes, starting at the top, are: 85%, 86%, 101%, 108% and 110%—lowest for wives of top businessmen and professionals, highest for wives of unskilled laborers.

Where doctors have a death rate from CVR of 129% their wives' rate is only 73%.

The keymen in the top class have a death rate from CVR, 2½ times that of their wives—more than six times for coronary disease and angina.

Americans more prone

In Canada and the U.S. we know the havoc of coronary disease among medical men and top business executives.

But we did feel this was a North American characteristic, associated with the rush and high nervous tension of life over here.

It's a surprise to know it exists in Britain

Can it be possible that the figures for North America are even worse than the report indicates?

Work done by the writer some years ago indicated that people in the U.S. were more prone to death from CVR disease than those of Britain.

Investigations among members of the American Medical Association, in a period centring on 1941, showed a much heavier mortality from CVR than the general U.S. white population (ages 45-64—134%).

An investigation centring on 1951, showed an improvement (113%) but a rate still definitely worse than average.

Considering the advantages of top business executives and professional men, particularly doctors, in education and claims on the best services money and medicine can provide, it is remarkable that there should be any disadvantage at all.

But they are definitely losing ground and the outlook is that the trend will continue.

The British investigations showed death rates from coronary diseases were less for manual workers than for nonmanual workers.

Is this the contributory cause?

A combination of tense, keenly alive existence with the reduced physical effort made possible by the automobile motor may have the wrong kind of effect on the human motor—the heart.

DUST EXPLOSIONS IN AIR

Dust produced in industry poses both long-term and short-term health hazards. Long-term hazards include silicosis and similar diseases which appear after years of exposure to certain dusts. An article about these dusts appeared in the Spring 1958 issue of this publication. However, there are other dusts which are potentially hazardous, not because they are toxic but because they are flammable. These are the dusts that explode if they are ignited.

Information is available on the ignition temperature and relative flammability of many different types of dust, the minimum concentration of dust required to form an explosive mixture with air, the maximum pressure and rate of pressure rise that may be expected following ignition and, in some instances, the inhibiting effects of inert dusts or gases that may be present in the mixture. This information provides the basis for developing standards for preventing dust explosions.

Combustible or readily oxidized material, fine enough and dry enough to form a cloud in air, will explode if the concentration of the dust is within certain limits and a sufficiently large or intense source of ignition is present. Because of this, industrial engineers, safety directors, or other officials responsible for plant protection and the welfare of persons exposed to dusty conditions should understand the factors that contribute to dust explosions, the conditions under which they start, and the steps that can be taken to prevent them or minimize damage if they occur.

Conditions Conducive to an Explosion

All industrial plants handling finely divided combustible material have many possible combinations of circumstances that may produce the conditions necessary for an explosion.

*Reprinted from Michigan's Occupational Health, Vol. 4, No. 1, Fall, 1958.
Published by Occupational Health Div., Michigan Department of Health.

Photograph above, Smoke Emerging from an Elevator after Explosion
The Camera Shop, Port Arthur, Ont.

Many explosions start in or around grinding machinery. The process produces dust or fine particles either as the desired product or as a by-product, and there are numerous possible sources of ignition. Foreign material, such as nails, bolts, or stones, may enter the grinder and produce sparks, or the metal may be heated by friction or impact within the grinder until it gets hot enough to ignite the dust.

Other dust explosions occur in sifting or screening operations. Dust clouds are normally produced in such equipment, and static sparks are frequently believed or assumed to be the source of the ignition.

Conveyors may create dust clouds either during normal operation or when they are over-loaded or break down. Frictional heat or sparks produced by impact of moving metallic parts may then be responsible for dust ignitions.

Mixing and blending operations generally produce dust clouds, and static or metallic sparks are believed to be capable of causing their ignition.

In driers or kilns, dust clouds frequently are formed during normal operation. This applies particularly to spray dryers in which explosive concentrations of the fine dried material may be present at the beginning or for prolonged periods of each run. The source of heat for the drier may be the source of ignition for the dust cloud.

Saws, cutters, shapers, and sanding machines may create explosive dust clouds. There is always the possibility of ignition by sparks or heat produced in such operations.

Under certain circumstances, equipment installed for collecting and removing dust may create conditions that could cause an explosion. Heavy concentrations of dust are sometimes handled through suction hoods and air lines. Research has established that high-voltage charges of static electricity may be formed on ducts or on dust particles. If proper grounds are not provided, sparks produced by the accumulated charges may ignite the dust in suspension in ducts or in the collector.

In many plants it is impossible to retain the dust within the processing and handling equipment. Consequently, as fine particles of combustible material become scattered through the atmosphere of the plant, explosive mixtures are formed where many sources of ignition may be present. Unprotected electric lamps and unapproved electrical equipment are possible sources of ignition under such conditions. Sparks produced by tools, shoe taps and nails, smoking, welding and cutting flames, heating devices and small fires caused by spontaneous heating or other causes may be responsible for setting off a dust explosion.

Factors that affect Explosibility of Dusts

The ignition sensitivity of dusts and the violence of explosions depend on several interrelated properties of the dust and on surrounding conditions. Some of these are:

Chemical and physical properties of dust.—Among chemical and physical properties of dusts are composition, affinity for oxygen, heat of combustion volatile matter, moisture and ash content, specific heat, and particle size.

Size, shape, and surface structure of dust particles influence their explosive characteristics. In general, explosibility of dusts increases with a decrease in particle size, because finely divided dust has a higher specific surface area. This means better mixing of particles with oxygen, more rapid vaporization, and higher rate of oxidation. The electric capacitance per unit weight of fine dust is greater, therefore larger charges can be developed. Fine dust, too, is more readily dispersible and remains in suspension longer.

Dust concentration and uniformity of dust clouds.—To cause an explosion, the concentration of dust in a cloud must lie between certain limits. The lower explosive limit corresponds to a concentration at which there is barely enough dust in the air to propagate flame. The upper limit may be defined as the concentration at which the heat produced by complete oxidation of a portion of the dust in the available oxygen is just enough to heat the rest of the dust in the mixture to ignition temperature. Actually, dust clouds do not have definite upper limits, because, as the concentration increases, partial burning of all the dust takes place.

Composition of atmosphere.—Initial temperature, pressure, oxygen content, flammable vapor and gas content, humidity, specific heat, and heat conductivity of the atmosphere all influence dust explosions. In practice, oxygen is the most important factor. Most dusts do not ignite and propagate flame if the atmosphere contains insufficient oxygen. This fact is utilized in several industries to provide protection against explosions. The explosion hazard of dusts, however, is greater in oxygen-rich atmosphere than in air.

Ignition source.—The importance of temperature, energy, and surface area of the ignition source and time of contact with the dust have been mentioned. Most industrial dusts ignite more readily by flames and hot surfaces than by electric sparks, but there are some exceptions.

Explosion space.—Size, shape, strength, and other features of the explosion space have an important bearing on dispersion and formation of the dust cloud, initiation and development of an explosion, flame speed, and pressure relief. These, in turn, determine the degree of destruction produced by an explosion.

Effect of moisture.—Free and combined moisture in dust usually acts as an incombustible. Energy is required to heat and vaporize moisture, reducing the energy available for ignition of the dust cloud. The water vapor acts as an inert gas, diluting the atmosphere. Frequently, a more important effect of moisture is its ability to wet and agglomerate dust particles, thus reducing their dispersibility.

Hazards of Dormant Dust

Secondary explosions.—Although it is true that to produce explosions dust must be dispersed, the potential hazard of undispersed combustible dust on exposed surfaces in the path of an explosion or near the source of ignition must not be neglected. The first ignition frequently involves only a small dust cloud and causes little damage, but if enough dust is present on nearby surfaces, this may be dispersed, causing a second and possibly, a third much stronger explosion.

Spontaneous combustion.—Spontaneous heating and combustion is of great importance. Since the process is essentially a surface reaction, powdered products are often more capable of heating than solid material in bulk. Many substances, both organic and inorganic, are subject to spontaneous heating. They include coal, agricultural products, certain metal powders, charcoal, and other porous materials, as well as paints, oils, and chemical compounds.

When stored under certain conditions in large quantities, some substances begin to heat at room temperature, but in most instances heating does not begin unless the ambient temperature is elevated. Initially the

Table I **EXPLOSION CHARACTERISTICS OF VARIOUS DUSTS**

TYPE OF DUST	Ignition Temperature of Dust Cloud, Degree C.	Minimum Spark Energy Required for Ignition of Dust Cloud, Millijoules	Minimum Explosives Concentration, Oz. Per Cu. Ft.	Maximum Explosion Pressure, P.S.I.	Rates of Pressure Rise, P.S.I. Per Second		Limiting Oxygen % to Prevent Ignition of Dust Cloud by Electric Sparks
					Average	Maximum	
Metal Powders							
Aluminum, atomized	700	50	0.040	58	1,050	2,250	3
Aluminum, stamped	645	20	0.035	89	2,150	5,700	
Iron, hydrogen reduced	315	160	0.120	29	650	1,200	13
Magnesium, atomized	600	240	0.030	57	750	1,450	< 3
Magnesium, milled	520	80	0.020	65	1,500	3,150	b
Magnesium, stamped	520	20	0.020	72	4,400	4,750	b
Manganese	450	120	0.210	25	200	300	15
Silicon	775	900	0.160	62	450	1,200	15
Tin	630	160	0.190	26	250	400	16
Titanium	480	120	0.045	44	750	1,100	b
Vanadium	500	60	0.220	34	200	300	13
Zinc	680	900	0.500	13	150	300	10
Zirconium	a	15	0.040	42	1,450	4,000	b
Dowmetal	430	80	0.020	56	1,600	2,550	
Ferrotitanium, low-carbon	370	80	0.140	34	600	1,400	13
Ferrosilicon (88% Si)	860	400	0.425	36	200	300	19
Magnesium-aluminum (50-50)	535	80	0.050	61	2,250	3,000	b
Plastics							
Allyl alcohol resin	500	20	0.035	68	1,750	3,550	
Casein	520	60	0.045	49	200	500	17
Cellulose acetates	320	10	0.025	82	1,200	2,400	14.5
Cellulose propionate	460	60	0.025	66	1,350	2,350	
Coumarone-indene resin	520	10	0.015	63	1,350	3,000	14.5
Hexamethylenetetramine	410	10	0.015	64	950	2,550	14.5
Lignin resin	450	20	0.040	69	750	2,700	17
Methyl methacrylate	440	15	0.020	57	550	1,200	14.5
Pentaerythritol	450	10	0.030	65	1,000	2,150	14.5
Phenolic resin	460	10	0.025	61	1,350	3,150	14.5
Phthalic anhydride	650	15	0.015	49	1,250	1,700	14.5
Polyethylene resin	450	80	0.025	83	400	1,250	15
Polystyrene	490	120	0.020	44	350	650	17
Shellac, rosin, gum	390	10	0.015	58	1,250	3,000	14.5
Synthetic rubber, hard	320	30	0.030	59	750	1,850	15
Urea molding compound	450	80	0.075	63	700	1,800	17
Vinyl butyral resin	390	10	0.020	60	450	1,000	14.5
Agricultural Products							
Alfalfa	530	320	0.100	66	500	1,100	
Cellucotton	440	60	0.050	70	800	2,250	
Citrus peel, dehydrated	490	45	0.065	51	600	1,000	
Clover seed	470	80	0.060	49	....	....	17
Cornstarch, modified	470	40	0.045	72	1,050	2,150	
Corncob, ground, dried	400	60	0.030	64	1,300	2,150	
Onion, dehydrated	410	...	0.130	60	400	1,300	
Pea, dehydrated	560	...	0.050	68	800	1,950	
Peanut cracklings	570	370	0.085	41	200	350	
Rice	490	80	0.045	61	850	1,350	
Soybean	560	100	0.040	65	800	2,450	17
Tung kernels	540	240	0.070	74	650	1,950	
Wheat, cracked	470	160	0.060	58	....	....	
Miscellaneous							
Aluminum stearate	400	15	0.015	62	750	2,100	
Bark dust, Douglas fir	540	40	0.030	60	800	1,800	
Coal, bituminous	610	40	0.035	46	350	800	16
Coal-tar pitch		80	0.080	49	350	650	15
Crude rubber, hard	350	50	0.025	57	850	3,350	15
Dinitro-ortho-cresol	440	...	0.025	55	1,300	2,250	15
Gilsonite	580	25	0.020	56	900	1,850	
Phenothiazine	540	...	0.015	43	600	1,450	16
Soap	430	60	0.045	60	660	1,300	
Sulphur	190	15	0.035	41	700	1,950	11
Thyroid, desiccated	610	60	0.060	64	550	1,200	
Wood flour	430	20	0.040	62	850	2,100	17

a When zirconium powder was dispersed into air at room temperature, it ignited under some conditions, apparently due to static electric discharge between the particles in the dust cloud.

b The oxygen reduction tests were made in air-CO_2 mixtures. Dust clouds of zirconium, magnesium, titanium, and certain magnesium-aluminum alloys ignited in pure CO_2.

* *By permission from Mechanical Engineers' Handbook, by Lionel S. Marks (editor). Copyright, 1951, McGraw-Hill Book Company, Inc.*

heating may be caused by external sources, such as flames, hot surfaces, and friction. The presence of small quantities of moisture often accelerates spontaneous heating.

With hay, starch, sugar, cellulose, and other materials, initial heating is thought to result from fermentation or some other microbiological action. As the temperature rises, this action is supplanted by chemical oxidation of the material. In other cases, the entire process may be due to the action of atmospheric oxygen on the combustible substance.

Preventive measures against spontaneous heating vary according to the nature of the material involved. Storage in cool areas removed from external sources of heat and free of moisture is usually recommended.

Pyrophoric dusts.— Some very finely divided metal powders (iron, manganese, copper, uranium, nickel, cobalt, chromium, lead, tungsten, molybdenum, zirconium, and others), metal oxides, hydrides, carbides, nitrides, and metal alloys oxidize so rapidly on exposure to air that they heat and ignite. In some instances this action occurs at room temperature; in others, only at elevated temperatures. There is no agreement regarding the exact mechanism of pyrophoric ignition. The process probably varies somewhat with the type of dust, its fineness, surface character, and other properties. Some proposed remedies for avoiding ignition are to store the powder in small batches, to keep it away from direct sunlight and other heat sources, to provide storage under protective liquids or in inert gases, and, in some cases, to permit slow but limited access of air to the powder before complete exposure to air.

Effect of Static Electricity

Static electric charges develop whenever two dissimilar surfaces are pressed together and separated. The charge may become appreciable when one or both of the surfaces are non-conductors and when the atmospheric humidity is low. In industry, electro-static charges can develop on dust and on dust-containing equipment during grinding, mixing, sieving, and transportation of dust through ducts and on conveyors, and also from transmission of power by belts, movement of vehicles and people, and during other operations involving motion.

The best measure against ignitions by static sparks is prevention of accumulation of electric charges on equipment, and, if necessary, on operating personnel. This can usually be accomplished on equipment by careful bonding of all conductive parts of the equipment and by connecting them to a common ground. Other methods that can be employed are ionization of the air, which promotes neutralization of static charges; maintenance of high atmospheric humidity, which assists charge leakage by formation of a thin film of moisture on surfaces of equipment; and design of the system to reduce its electric capacitance.

Classification of Explosive Dusts

There is great variation in published data for the lower explosive limits of dust clouds, because fineness, dispersibility, uniformity of dust cloud, igniting source, timing of ignition, and interpretation of what constitutes limiting flame propagation are the determining factors. Published figures for the lower limit of aluminum powder range from 7 to more than 400 mg/liter. The range in values for the dusts studied by the Bureau of Mines is from 10 to 15 up to several hundred milligrams per liter.

Many procedures have been proposed for rating the relative explosion hazards of dusts. These include classifications according to ignition temperature, volatile content, lower explosive limit, minimum energy required for ignition, flame velocity, pressures and rate of pressure rise developed by dust explosions, ratio of heat of combustion to the heat necessary to bring the dust cloud to the ignition temperature, and the percentage of inert dust needed in a mixture with the combustible dust to prevent ignition and flame propagation under certain standard conditions (termed "relative flammability"). Table 1 lists the explosion characteristics for various dusts.

Actually, no single characteristic is adequate to classify the sensitivity of dusts, to ignition and the destruction that may result from explosions. However, as a result of coal mine explosion studies by the Bureau of Mines, dusts are occasionally grouped according to their relative flammabilities.

It is not possible to discuss in detail the behaviour of all types of dusts. A few general statements can be made that will indicate the effect of certain factors upon the explosibility of some dusts and permit certain group classifications that will indicate the relative explosion hazards in plants handling such products.

Carbonaceous dusts.—More than 130 carbonaceous dusts have been tested and classified according to their explosibility. This group includes coal, virtually all of the grain dusts, such as corn, wheat, oat, barley, and rye dust, and the products of milling, such as flour, feed, meal, starch, and malt. Other examples of carbonaceous dusts tested and classified are wood flour, powdered milk, spices, tobacco dust, powdered sugar, cocoa, drugs, leather dust, and certain insecticides. The maximum rate of pressure rise that indicates the severity of the explosion hazard ranges from low to high for dusts in this group. Grain dust is considered to have a low rate of pressure rise—200 pounds per square inch

per second. Coal dust has a medium rate of pressure rise—780 pounds per square inch per second, and cornstarch has a high rate of pressure rise—1,590 pounds per square inch per second.

Metal powders.—More than 50 samples of metals and alloys have been tested in the laboratory and classified according to their relative inflammability. This group includes aluminum, antimony, iron, lead, magnesium, tin, titanium, zirconium, and alloys or mixtures of these or other metals among the 30 or more now available in powdered form. Ignitions and explosions of metal powders may occur under the same conditions required to produce explosions of carbonaceous dusts, and like the first group, the maximum rate of pressure rise for the metal powders ranges from low to high.

Lead powder is one of the group that presents virtually no dust-explosion hazard. Although lead dust clouds can be ignited at 580° C., and the relative inflammability is 20, the maximum pressure produced is only 2 lb./sq. in., and the maximum rate of pressure rise is only 50 lb./sq. in./sec.

Tin can be classified in the group that presents a moderate or medium explosion hazard, because it produces a maximum rate of pressure rise of 850 lb./sq. in./sec.

In the group that presents a high or serious explosion hazard, there are several outstanding examples—aluminum, magnesium, and zirconium. A sample of aluminum produced the highest rate of pressure rise measured in this series of tests—5,700 lb./sq. in/sec.

Zirconium is included in the particularly hazardous group because it has a maximum rate of pressure rise of 2,570 lb./sq. in./sec., and because of its ease of ignition. A number of ignitions were obtained at room temperature without any outside source of heat or flame when a quantity of the finely divided powder was blown into the air. Ignitions are believed to be due to static electricity on the dust particles.

Plastic powders.—More than 50 samples of synthetic resins and powders used in the plastic industry have been tested in the laboratory and classified according to their relative explosibility. The group includes phenolic, urea, vinyl and other types of resins and a number of molding compounds, primary ingredients, and fillers. Many of these powders were found to present a greater dust-explosion hazard than common carbonaceous dusts.

The plastic powders, like the carbonaceous and metallic dusts, can be grouped to indicate their explosibility, depending on whether the rate at which pressure is produced following ignition is low, medium, or high. Some of the resins have comparatively low rates of pressure rise (less than 500 lb./sq. in./sec.) and others, principally the urea resins, have rates of pressure rise below 1,000 lb./sq. in./sec., which permits them to be placed in the medium class. Many samples tested had maximum rates of pressure rise exceeding 2,000 lb./sq. in./sec., and therefore the great majority of the powders used in the plastic industry must necessarily be considered in the high-hazard group.

Venting Pressure

In certain instances, devices can be employed to vent or dispel the pressure built up in a dust explosion and thus prevent serious damage to equipment or the building housing it. The adoption of such protective measures should not be made the excuse for neglecting well-recognized standards for preventing dust ignitions.

Vents in the form of light, frangible disks on equipment, hinged windows, or panels in building walls, skylights and special ventilators may be used for protection against dust explosions, but to be effective it is necessary to maintain the proper ratio between vent area and volume to be vented. Information on this ratio is not available for all dusts or all types of equipment. As a general rule, 1 square foot of vent area should be provided for each 80 cubic feet of volume, if the explosion to be vented is of the type that has a low rate of pressure rise. Where the dust being produced or handled is capable of producing an explosion with a medium rate of pressure rise, the ratio should be 1 square foot of vent to 40 or 50 cubic feet of volume; and where the rate of pressure rise is high, the maximum possible venting area should be provided.

It is generally possible by providing a weak wall or roof to obtain a venting area of 1 square foot for each 10 or 20 cubic feet of volume.

Explosion Prevention and Protection

In a plant where a spark or small fire may cause a serious explosion, fire prevention and fire protection are of the utmost importance. However, it is a difficult problem to provide such protection under conditions where the use of water and common types of fire extinguishers will serve only to intensify the fire. Water causes oxidation and the release of hydrogen. Hose streams, or gas jets may throw dust into suspension and form explosive dust and air mixtures.

Inert gas atmospheres that may retard ignition are ineffective in extinguishing fires that are well-started. Fine water spray and fog nozzles can generally be used without too much danger, although water will accelerate the burning of certain metals.

Small fires can be extinguished by using sand, talc, or rock dust. By forming a dike or ring about burning

powder the fire can be segregated and allowed to burn itself out after making certain that it does not spread to other areas.

Protection becomes largely a question of fire prevention, although a few recommendations based upon experience can be made:

1. *Cleanliness* is of the utmost importance. Dust should not be allowed to accumulate where it might be thrown into suspension in air and form an explosive mixture.
2. *Powders* should be kept dry to prevent heating and possible ignition.
3. *All equipment* should be grounded to prevent accumulation of charges of static electricity.
4. *Precautions* should be taken to prevent formation of metallic or electric sparks.
5. *All electric* equipment and wiring in dusty areas should be of types designed for hazardous locations and installed in accordance with the requirements of Article 500 of the National Electrical Code.
6. *Magnetic* separators should be used to remove tramp iron or other foreign material that might produce sparks in the mills or polishers.
7. *Use of gas* or electric cutting and welding equipment constitutes a serious fire and explosion hazard. Such operations should be prohibited in dusty areas. Other open flames and smoking should also be prohibited.
8. *Properly supervised* maintenance and repair work are essential. If emergency repairs become necessary and the work cannot be performed elsewhere, all dust-producing operations should be stopped and the area properly cleaned before the job is started. As far as possible, non-sparking tools should be used for repair work and for other activities.
9. *Heating* should be by hot air only, with provision for heating the air with steam coils located outside the dust-producing section.
10. *Explosion* vents should be provided in accordance with the requirements of National Fire Protection Association. Pamphlet 68 "Guide to Explosion Venting."
11. *To reduce* the hazard from fire and explosion it is recommended that the powder-making section of a plant be segregated from other parts or buildings and divided into small units.
12. *Buildings* used for powder-making should be only one story, with a roof as light as practical and arranged to lift off readily in case of an explosion.
13. *Buildings* should be separated by not less than 50 feet of space with powder-making buildings at least 300 feet from occupied structures.
14. *Dry sand*, talc, or other powders to be used to extinguish small dust fires should be stored in clearly marked or indicated containers at strategic points.
15. *Fire companies* that may respond to alarms from the metal-powder-producing section should be warned against the use of water or extinguishers that may disturb the dust or intensify the fire.

NOTICE OF AIR POLLUTION CONFERENCE

All interested persons, Government Departments, Municipalities, Companies, Associations and other bodies concerned with air pollution are invited to participate in the Diamond Jubilee International Conference sponsored by the National Society for Clean Air to be held in London, England, October 20 to 23, 1959.

The purpose of the Conference and Exhibition is to exchange information and promote co-operation, internationally, on the practical aspects of the prevention and control of air pollution.

The programme will take the form of six main conference sessions to be held during the first three days; the final day to be devoted to visits and excursions of air pollution interest. The themes of the sessions will include: Legislation, Public Opinion and Education, Technical Papers, International Co-operation, Research and Investigation.

The Exhibition to be held in conjunction with the Conference will be primarily technical and informative in character, and will demonstrate the means that are available for the prevention of air pollution.

The Registration Fee of £4 will include receipt, without further charge, of the printed Advance Papers.

Any further information will be forwarded on request. Inquiries and other correspondence should be addressed to Mr. Arnold Marsh, Palace Chambers, Bridge Street, S.W.1., England.

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